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ABSTRACT

The intent of this field tested instructional package is to acquaint the student with materials used by industry for the production of goods and services. Defining behavioral objectives, the course description includes a media section, suggested classroom activities, and sample student evaluation forms, as well as the basic information section. It deals with the origins of natural and manmade materials and the process industry uses when selecting a material to be used in producing goods. This process includes the consideration of the composition of materials, how the material is processed, where it is available, what it costs, what it looks like, and whether or not it will do the job it is supposed to do. (Author/MW)

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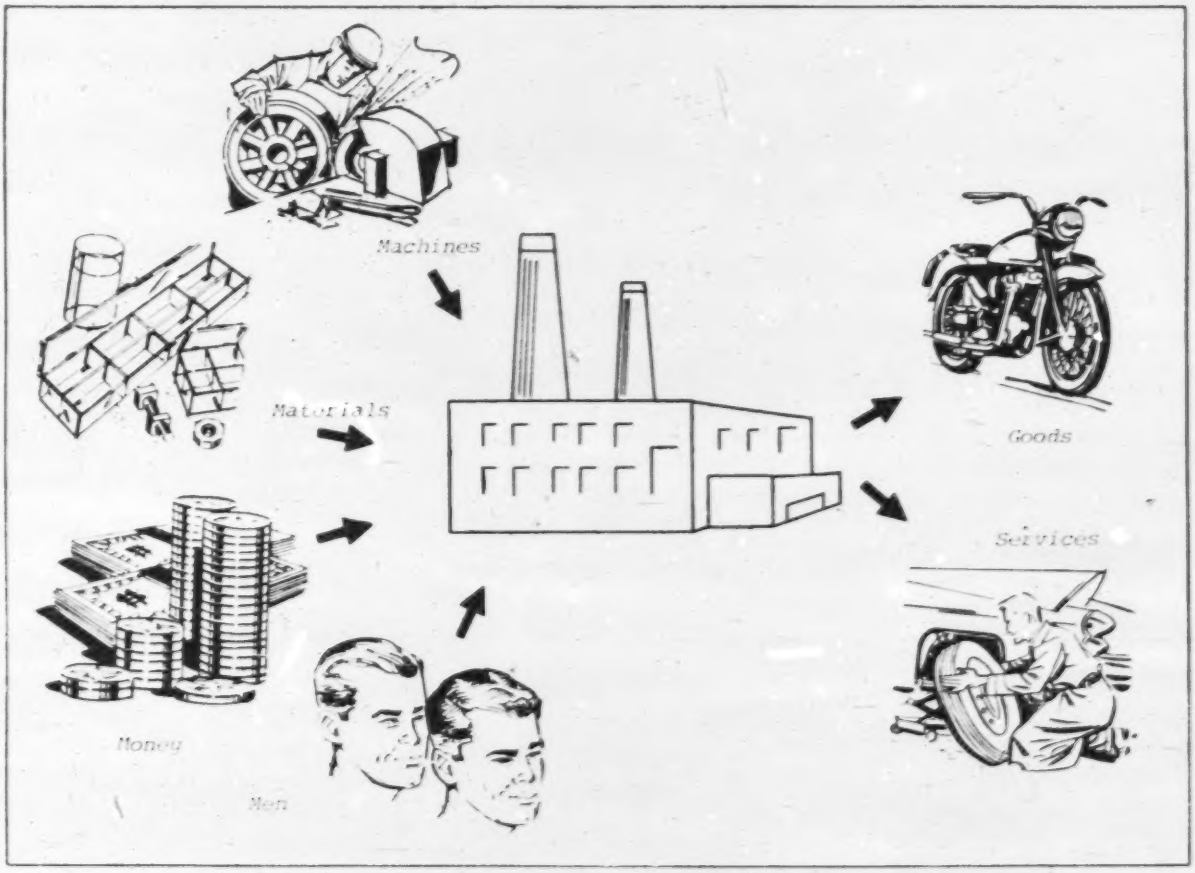
GETTING TO KNOW MATERIALS



Prepared as an Aid in Implementing
The Wisconsin Guide to Local Curriculum
Improvement in Industrial Education, K-12

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Learning Activity Package

Prepared as an Aid in Implementing
The Wisconsin Guide to Local Curriculum
Improvement in Industrial Education, K-12

Materials

Junior-Middle High School

Pertaining to Field Objective Number One

"To provide students the opportunity to work
with materials of industry to gain an understanding
of how they function in providing goods and services"

Produced by

The Industrial Education Instructional
Materials Development Project
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University of Wisconsin-Stout

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RATIONALE:

Have you ever made anything? What did you use to make it? How did you decide what kind of material to use? Where did you buy it? How much did it cost? Would a different material have worked better . . . or performed a better job . . . or have been less costly?

Whenever you or I - or industry makes a product, a material must be considered. Industry must ask itself questions similar to the ones above. It must decide the best possible material to use to produce the best possible product that you and I use.

This package deals with materials; where they are found; different kinds; and their characteristics and selection.

OBJECTIVES:

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Terminal Objective:

To provide you with the opportunity to work with materials of industry to gain an understanding of how they function in providing goods and services.

Enabling Objectives:

1. You will define, in your own words, 'materials' as they relate to industry.
2. You will list and define four (4) general sources of materials.
3. You will name and define the characteristics of properties of materials that are considered by industry before a material is selected for a product.
4. Given the name of a product or part, you will select a material from a given list that would be best suited for that product or part. You will tell why this material is best suited using industrial terms.

Options: Read the self-test on the following pages and then check the following selections that apply to you.

_____ If you feel you can meet the above objectives:

_____ A. See the instructor for a teacher evaluation.

_____ B. Take the self-test as a self evaluating device, then see your instructor.

_____ If you feel you cannot meet the above objectives:

_____ A. Take the self-test to see what objectives your studying should be based upon, then turn to the media section on page 5.

_____ B. Skip the self-test and turn to the media section on page 5 to help you achieve the objectives.

Self-Test:

1. Define in your own words, 'materials' as they relate to industry.

2. Name and define four general sources of materials.

   a.

   b.

   c.

   d.

3. Define, in your own words the following properties of materials:

   Hardness -

   Ductile -

   Brittle -

   Malleable -

   Impact resistance -

4. Identify the characteristics of the following properties of materials:

   Tension -

   Compression -

   Shear -

   Torsion -

5. Select a material from the list on the right that would be best suited for the product named on the left.

   Tell why you chose the material for the design of that product using industrial terms and properties mentioned in this package.

   Name another material and tell why it would not be used for the named product. Use a separate sheet of paper.

1. Coffee table	Wood
2. Cup for a baby	Glass
3. Bird house	Paper
4. Car tire	Plastic
5. Saw blade	Cotton
6. Milk container	Steel
7. Weaving apparel	Aluminum
8. Car battery	Rubber
9. Bleach container	Clay
10. Toaster	Copper
	Lead
	Brass

MEDIA SECTION

Objective Number 1: Define in your own words, materials as they relate to industry.

Optional Media: (check one or more of the following sources)

___ 1. American Industry, student booklet, Operating an Industry, page 23 to paragraph one on page 25.

___ 2. Read the information in this package on page 7.

Optional Activities:

___ 1. Materials - I-1A

___ 2. Materials - I-1, 2, 3

Objective Number 2: List and define four general sources of materials.

Optional Media: (check one or more of the following sources)

___ 1. American Industry, "Operating an Industry", Vocabulary section.

___ 2. General Industry, Lindberg and Lathrop
pp. 64-72
154-162
220-224
238-242

___ 3. Read the material in this package on pages 7 thru 9.

___ 4. View the film: "Lead from Mine to Metal"

Optional Activities:

___ 1. Materials - I-2A

___ 2. Materials - I-2B

___ 3. Materials - I-1, 2, 3

Objective Number 3: You will name and define the characteristics or properties of materials that are considered by industry before a material is selected for a product.

Optional Media: (check one or more of the following sources)

___ 1. Use a good dictionary and look up characteristics listed in this package.

___ 2. Plastics Technology, by Swanson, pages 21-27. This book is about plastics but is an excellent source for definitions of material characteristics.

___ 3. Engineering Metallurgy. Check the index for the properties. Good source of information.

___ 4. Read the information in this package on pages 10 thru 16.

Optional Activities:

___ 1. Materials - I-3A

___ 2. Materials - I-3B

___ 3. Materials - I-1, 2, 3

Objective Number 4: Given a product or part, select a material that would be best suited for that product or part.

Optional Media: (check one or more of the following sources)

___ 1. Materials and Processes in Manufacturing, by DeGarmo. Consult index for products or materials.

___ 2. Plastics Technology, by Swanson. Consult index and look for products of plastics.

___ 3. Read the information in this package on pages 10 thru 16.

___ 4. View these film: Man Made Fibers

Plastics, Industrial Processes and Products

Looking at Glass

A Stretch of the Imagination
America's search for a rubber substitute

Activity:

___ 1. Materials - I-4

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Definition of Materials:

Name any product that you have seen. It is produced by industry or individuals, and it is made of something. Industry takes substances and bends, forms, melts, paints and does all sorts of things to produce products. We can define materials simply as:

substances from which products are produced.

Sources of Materials:

Where does industry get the materials needed to produce the products we use? Sources of materials can be natural or man-made. Natural sources include two areas: extracted and grown. Man-made (or man-ufactured) sources include combining and conditioning.

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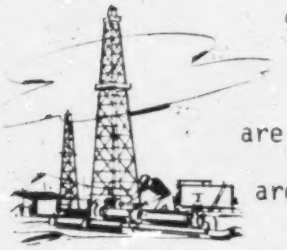
EXTRACTED
GROWN ⬅ **NATURAL**

COMBINED
CONDITIONED ⬅ **MANMADE**

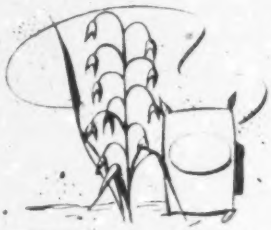
Extracted: Some examples of extracted materials are: coal, oil, gas, sand, gravel, iron, copper or aluminum.



What do these materials have in common? First, they are from nature. Secondly, none of them breathe - they are non-living.

Extracting is taking non-living substances or materials from nature so industry or you can use them in making products.

Grown: Growing is another source of materials. How do things grow? Take the example of how you and I grow: We take in food, we exercise and grow physically. Mentally, we take in things that happen around us and we learn and develop.



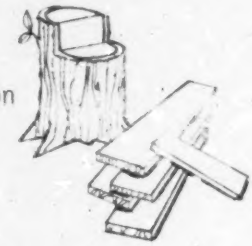
What is happening?

We grow and develop - physically and mentally, seemingly without trying. We do not even have to think about it. It comes naturally to us.

So - growing is taking in nourishment and development takes place naturally.

What are some examples of materials that are grown?

What types of materials do we get from plants? - cotton rope, foods, paper.



Animals?

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Combining: Man combines substances to obtain materials.

Combining is the mixing or joining of substances to form materials that industry can use. Examples of materials that are combined are: cement, paint, ink, alloy steels, formica and plastics.

Can you think of more?

Conditioned: When a substance is conditioned, it is changed physically in some way. That is, it is bent, folded, textured, mutilated, cut, broken, heated or stretched in some way. Leather is conditioned when it is tanned to preserve it. Wood is conditioned when it is turned into charcoal. Your clothes are conditioned when your mother adds fabric softener to the wash. Is there anything else that is conditioned?

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Kinds of MATERIALS

If you were asked to name 100 materials, you would probably react and say: "Never - impossible." But, think for a minute. Look around the room. How many materials do you see? There are different materials all around us. The same material is used in many different ways.

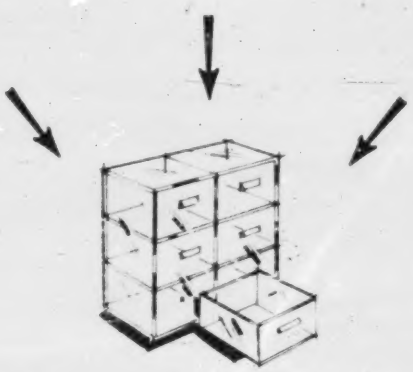
To try and classify materials and put them in neat little lists is a difficult task. It seems there are always exceptions, some materials do not fit into any areas. Others will fit into a number of areas.

---

3 5 7, 6 4 8, 3 8 8, 9 9 9

How many?

As you complete this package, think of a way that materials could be arranged and classified.



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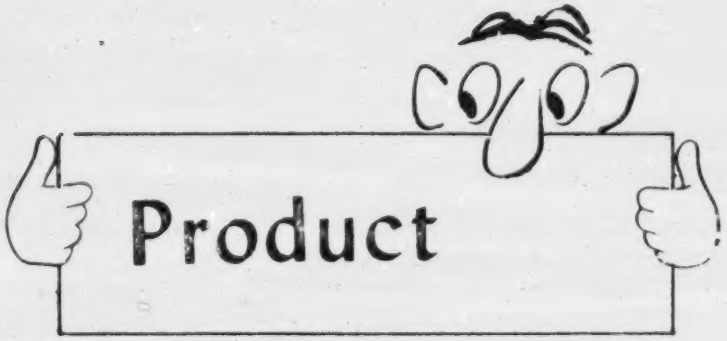
Characteristics/Properties

You were asked to name 100 materials, a hard task perhaps. But, just how many materials are there? How does industry decide what material they will use for a product? What questions do they ask when making a choice?

There are thousands of materials to choose from and industry uses the characteristics of a material to make its choice. They consider: the materials composition, how it is processed, where it is available, cost, what it looks like, and will it do the job or function that it is supposed to do. Industry looks at a product and its design, and the properties of the materials they are considering and makes a choice of the best material to use.



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Characteristics:

1. Composition: Materials are all composed, or made of something. The different compositions of each material give it specific properties that must be considered. These properties are physical, thermal, electrical, and chemical (perhaps these are familiar from a science class).

a. Physical: Physical properties tell or show what the material looks like; what we can see, feel and measure. How much does it weigh? If you were building a man-powered airplane, you would want light, but strong materials. Is it a solid, liquid or gas? Are special containers needed? How do you store oxygen? gasoline? sand?

Terms: Below is a list of terms industry uses to describe physical properties of materials. A definition, or what they describe, and some examples are given.

Hardness: to resist scratching or indentation. Example - how hard is foot powder compared to a diamond? or wood compared to steel?

Ductile: to stretch or pull material without breaking (sometimes called plastic). Example: a rubber band or taffy.

Brittle: opposite of ductile - or lack of ductibility. Example: glass, ice, peanut brittle, wooden match stick.

Malleable: can be shaped mechanically (like with a hammer or mall) without breaking apart. Example: Play Doh, soft metals as copper and silver. (any more?)

Impact resistance: resist being deformed by a sudden blow. Example: hit a piece of wood with a hammer; hit a piece of steel - what is the difference?

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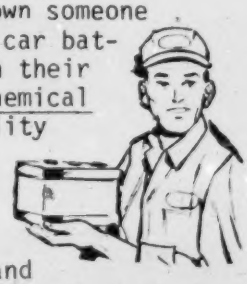
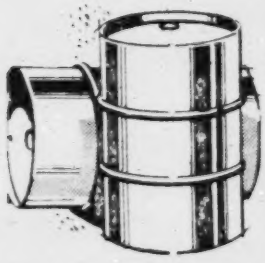
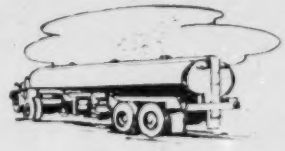
b. Thermal: Thermal properties describe how well the material "transmits" heat. For example: put one hand on a piece of metal and the other on a piece of wood. How do they feel? Why? This property also refers to how easily the material will burn - or resist a flame. This is important in building a home - as well as buying baby clothes.

c. Electrical: If electricity is involved in the product, the materials electrical properties will have to be considered. If you received a shock everytime you pushed the toaster down, or turned on the radio, or used an electric drill, or opened the refrigerator - how many of those products would people buy? A large part of the time people's lives depend on whether or not a material conducts electricity. Can you think of any job or materials that would illustrate this property?

d. Chemical: Have you, or have you ever known someone who has come in contact with a car battery and gotten battery acid on their clothing? What happened? A chemical property is the material's ability to react with other materials. For example: you own a big semi-truck to transport a corrosive material, such as acid. What kind of a tank and hoses and valves will you need? What material would they be made of? Wood? Rubber? Iron? Steel? Plastic? Fiberglass? Corrosion resistance is a chemical property of a material.







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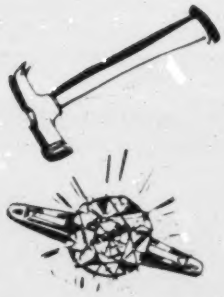
2. Process-ability: A material must be easily processed into a product. That is, how easily can the material be cut? machined? bent? folded? formed? Joined? welded? melted? poured? pulled or stretched? This is a materials processability. What machines will have to be used? Can you bend wood or metal? How? What do you use to cut diamonds or concrete? How about metal or plastics? They all require a different type of process. Industry must consider the process-ability of a material before it can begin to produce a product.



3. Availability: A material must be easily obtainable. Where can your company buy it? Is the supplier down the block, across town, in a different city or in another country? Is the supplier reputable, honest? How long has he been in business - 9 months or 25 years? How long will it take to get the material? Will the supply ever run out, as with some of our material and energy sources today. Industry considers how available the material is.

4. Cost: Cost can almost explain itself. We all go through this process every day. We ask ourselves, "How much is it?" and "Where can I get it at the lowest cost?" If the materials are expensive, the product will be expensive. Will we as consumers buy the most expensive item - or will a lesser one do?

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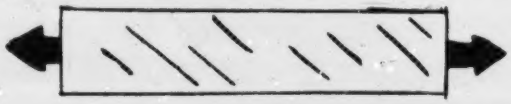
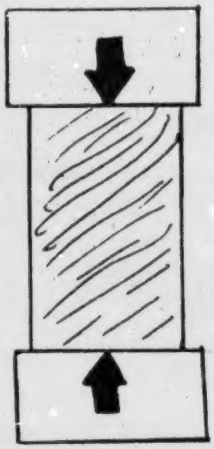
Here are some other important characteristics:

Tension - resistance to being pulled apart.



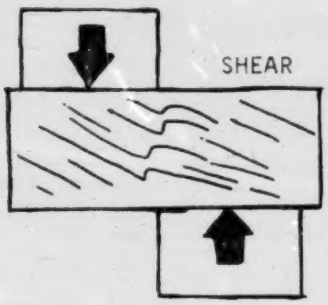
TENSION

Compression - resistance of a material to being squeezed.



COMPRESSION

Shear - resistance to fail or break under opposite loads - tending to slide by each other.



SHEAR

Torsion - resistance to a twisting force.

TORSION

What are some materials in a car that show these properties?

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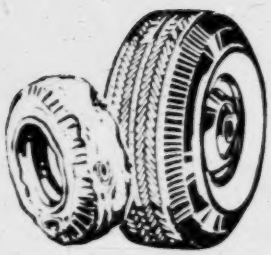
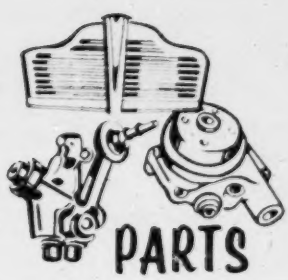
5. Aesthetics: This characteristic is concerned with what the material looks like, what it feels like. Does it have a pleasing appearance? Will people like or dislike the material? What color is it? Does it have a taste, odor, scent or smell? The material and product must leave a good impression with the people that come in contact with it.

FASHIONS

6. Function: Will the material do the job it is intended to do? Put a set of wooden wheels on your car. Will they do the function as well as rubber tires would? What would work better on a bicycle, a rubber band or a chain? Would you use a pair of pliers or a screwdriver to put a wood screw in a block of wood? Is the material going to the function it is supposed to do?





Activity: Materials - I-1A

Name _____

Period _____

Materials

Directions: Define in your own words, "materials" as they relate to industry.

Activity: Materials - I-2A Name _____

Period _____

Sources

Directions: Name and define four general sources of materials.

1.

2.

3.

4.

Activity: Materials - I-2B

Name _____

Period _____

Sources of Materials

Materials needed: Obtain from your instructor:

1. Transparent maps of the United States.
2. Colored pens (water soluble or grease pencil).

Procedures:

1. Consult:
   a. The National Atlas of the United States of America, United States Department of the Interior Geological Survey, Washington D.C.
   b. or an encyclopedia
   c. or ask your librarian or resource center personnel,

   for:

   Maps

   Atlases

   that tell or show:

   1. Where material resources are found
   2. Where major groups of industries are located

2. How?? . . . . . ideas

   Look in the index of the atlas or encyclopedia for such things as:

Economic	Organic Fuels
Business	Crude Oil and Products
Manufacturing	Natural Gas
Transportation	Mineral & Energy Resources
Communication	Power Production & Consumption
Petroleum	Fishing and Forestry
Coal	Rubber
Plastic	etc. . . . .

MORE → → → → → → → → →

3. The problem is: What to do with it?

   a. Choose 3 materials or material classifications you can find a map or atlas about that show the sources of those materials.

   b. Assign the materials you choose a color (of one of the colored pens).

   c. Shade or color in the areas on your map where the materials are located (Use one color & material for each transparency). Label each map telling material being shown.

   d. Choose a related industry that might use some of the materials you chose (consult index for ideas). Then shade or color the location of this industry on another transparency.

   e. Compare - by placing the materials map over the industry map, or one materials map over another materials map. See if you can find any groupings, relationships, patterns or overlaps.

   f. Take a few minutes and jot down the states or areas where you see any relationships . . . etc. Name the material and industry that you used.

   g. Submit these to your instructor.

Activity: Materials - I-3A

Name _____

Period _____

Material Failure

Directions:

1. Define the following characteristics of materials:

   Tension -

   Compression -

   Shear -

   Torsion -

2. Find some materials that have failed and broken.

   Bring them to school
   Clean them up
   Put a piece of tape on them and p t:

   Your name
   Type of failure (describe with one of the 4 terms you defined)

3. Submit to your instructor

Activity: Materials - I-3B

Name _____

Period _____

Materials Testing

Directions:

1. Obtain a box of materials from your instructor.

2. Identify the materials and record the number and name of the material on the Materials Testing Sheet on the following page.

3. Test each material you were given with the test given. Use the test listed on the right to describe the property being tested on the left.

   Describe the property using terms like:
   Excellent, good, fair, poor
   High, medium, low
   Hard, medium, soft
   or Think of some others . . . . .

4. Submit these to your instructor.

Activity: Materials - I-3B (cont.) Name _____

Period _____

Materials Testing Sheet

	Number of Material					
	Name of Material					
	Source					
Properties (Physical)	Method of Testing					
Hardness	Use a file					
Ductility	Bend back &					
Brittleness	forth					
Impact resistance	Use a hammer					
Compression	Use a vise					
Tension	Pull it					
Torsion (twist)	Grip with pliers					
Electrical	Put in electrical circuit					
Thermal	Use bunsen burner (and tongs)					
Example of a product						

Activity: Materials - I-3B (cont.)

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To the instructor: Some ideas

a) Some examples of materials to use:

Plastic
Styroform
Rubber
Sponge (wet and dry)
Wood (strips - 1/2" x 1")
Solder (roll)
Clay (wet and dry)
Asbestoes
Cloth
Metals (copper, steel, aluminum)
Glass
Leather
etc. . .

b) Affix a number to the materials you use

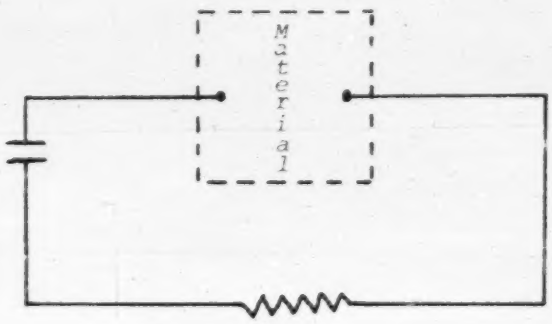
c) Can use a number of boxes with different materials in each of them

d) Post a list of materials used so students can choose or identify material they have.

e) Pre-cut pieces of same material - the same size

f) Equipment needed:
- Files, hammers, vise, pliers
- Electrical circuit

Use dry cell buzzer or light with contacts to lay material across to complete the circuit.



- Bunsen burner and tongs

Activity: Materials - I-1,2,3 Name _____

Period _____

Classification of Materials

Directions: Now that you have gone through this package and you understand something about materials:

1. Pretend you have a sample of all the different types of materials in the world piled in front of you.

   You have a large number of drawers or boxes behind you.

   You are going to store the materials in the drawers or boxes

   How would you do this?

   The problem is:

   To classify or arrange the materials in some order or system. Because with all the materials in the world we simply will not have enough boxes.

2. Make a chart, graph, or picture of your idea. Make it neat and readable.

   Everyone's idea does not have to be the same. It can be different or it can be the same. If your idea is different - good - stick with it and be ready to tell why you chose it!!

Activity: Materials - I-4 Name _____

Period _____

Products

Directions: Choose one of the products listed below - or any simple product you have around your house. Make a short list of the functions (what it does), and the characteristics of the material (using the terms mentioned in this package).

Mousetrap
Cup
Eating utensil
Can opener
Bottle opener
Can you think of any more?

The problem is:

To choose -

a material that you do not usually see this product made out of and . . .

To make -

this product out of the material you chose and decide whether it will perform the same function as you wrote at the beginning.

Student Evaluation

Materials

Name _____

Instructor _____

School _____

Directions: Answer all of the following questions to the best of your ability. The questions are written to evaluate your knowledge and understanding of the area of industrial arts covered in this package. Choose the answer which best completes the statement.

1. A good definition of the term materials, as it is used in industry, is:

   a. All of the matter on earth that has substance.
   b. Anything which is used or required to produce a product.
   c. Substances from which products are produced.
   d. Devices or apparatus necessary for doing or making something.

2. Materials used to produce a product are obtained by:

   a. Extraction from the earth
   b. Growth in plant or animal form
   c. Combination of other materials
   d. Conditioning a material to produce a new material with different properties.
   e. All of the above

3 & 4. Materials which are grown or extracted are (3) _____ and materials which are a result of combination or conditioning are (4) _____.

   a. Agricultural materials
   b. Man-made materials
   c. Natural materials
   d. Industrial materials

5. A roll of sheet aluminum is an example of a material which has been

   a. Grown
   b. Extracted
   c. Combined
   d. Conditioned
   e. Both B and D

6. The property of a material that refers to the ease with which it can be shaped mechanically is:

   a. Ductility
   b. Brittleness
   c. Impact resistance
   d. Malleability

7. When we say a material has the physical property of ductility, we mean that:

   a. It can easily be shaped by rolling, pressing, or hammering.
   b. It has a high resistance to scratching or indentation.
   c. It can be pulled or stretched without breaking.
   d. It is easily broken or shattered.

8. A steel rod which has a high resistance to rusting is an example of which of the following properties of materials:

   a. Chemical
   b. Biological
   c. Thermal
   d. Electrical
   e. Physical

9. An automobile drive shaft must have great _____ strength.

   a. Tension
   b. Compression
   c. Torsion
   d. Shear

10. Shear strength of a material is its ability to resist

    a. Failure under opposite loads
    b. Being cut or sheared
    c. Twisting forces
    d. Being squeezed or compressed
    e. All of the above
    f. A or B above

11. Styrofoam plastic is a good material for a disposable coffee cup because:

    a. It is ductile and has good thermal properties
    b. It is malleable and has high torsion strength
    c. It has the right electrical properties and is inexpensive
    d. It is resistant to attack by the acids in coffee and is very malleable

12. Aluminum is a good material for a lawn mower engine because:

    a. It dissipates heat well
    b. It is very resistant to wear on its load bearing surfaces
    c. It doesn't have to be painted
    d. It is so cheap and easy to obtain

13. You are asked to produce a table to be used in an electricity lab. You choose _____ as the material for the top.

    a. Wood
    b. Clear plastic
    c. Steel
    d. Aluminum